

Appl. No. : 10/666,618
Filed : September 18, 2003

AMENDMENTS TO THE DRAWINGS

The drawings filed on July 29, 2004, have been objected to. Applicants respectfully submit the enclosed four sheets of replacement drawings to replace those submitted with the application as filed. These four sheets of drawings constitute a resubmission of the originally filed photographs. No new matter has been included. Accordingly, Applicants respectfully request that the objection be withdrawn.

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REMARKS

Claims 4-10 and 15-20 are pending in this application. Claims 7, 15, 17, and 20 have been amended. Support for the amendments is found in the specification and claims as filed.

Objection to the Specification

The specification has been objected to as not reflecting the correct surface structure of silica as currently claimed. The specification has been amended to include correct structures. Accordingly, Applicants respectfully request that the objection be withdrawn.

Rejections under 35 U.S.C. § 112, second paragraph

Claims 7, 15, and 20 have been rejected under 35 U.S.C. § 112, second paragraph as indefinite. Claims 7, 15, and 20 have been amended to address the issues raised in the Office Action. Accordingly, Applicants respectfully request withdrawal of the rejection.

Claim Rejection - 35 U.S.C. § 103(a)

Claims 4-10 and 15-20 have been rejected under 35 U.S.C. §103(a) as obvious over any of Korean Laid-Open Patent 98-25282 (hereinafter "Lee II"), U.S. 5,814,574 (hereinafter "McNally"), EPO 0 839 836 (hereinafter "Sancho Royo"), and U.S. Publ. No. 2003/0144135 A1 (hereinafter "Llinas et al.").

The Office Action asserts that it would have been obvious to a person of ordinary skill in the art given the identities of the side groups on the various transition metal compounds of the primary references that it would be reasonable to expect that such surface species would have been formed from dehydroxylated silica. As acknowledged in the Office Action, none of the primary references explicitly discloses use of a silica support that has been dehydroxylated, and none of the primary references disclose that the silica support after reaction with the transition metal compound includes an alkoxy group derived from the transition metal compound.

None of primary references specifically disclose a supported metallocene catalyst wherein the metallocene comprises a moiety corresponding to A' as presently claimed in Claims 4 and 7 or $-(CH_2)_a-CR''_2-Z-CR'_2G$ as presently claimed in Claim 15 and 20, which is subsequently bonded to a silicon atom of the dehydroxylated silica support via an oxygen atom as recited in the pending claims. Lee II describes a supported metallocene catalyst prepared by cleaving the RO-Si (oxygen-silicon) bond by a reaction of a siloxane group (-Si-O-Si-) having high reactivity of dehydrated silica and a siloxy group (RO-Si-, R= alkyl or aryl) of the metallocene compound. McNally discloses a preparation of a catalyst in which the Et_2AlCl (Lewis acid) compound is

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reacted with dehydroxylated silica, and then it reacts with a metallocene compound having an oxygen (Lewis base) group to yield a metallocene catalyst bonded to the support by an Al to O bond ($\text{Al} \rightarrow \text{O}$). Sancho Royo discloses a supported metallocene catalyst prepared by cleaving the RO-Si bond by a reaction of a silanol (-Si-OH) group of non-dehydrated silica and a siloxy group (RO-Si-, R= alkyl or aryl) of the metallocene compound. However, the activity of the supported metallocene drops significantly due to the unavoidable formation of RO-H during preparation of the supported metallocene. Llinas et al. discloses a metallocene compound having an alcohol group as a terminal group. According to the Examples, the Llinas et al. catalyst is prepared by formation of an Al-O bond through a reaction of the metallocene compound with an alcohol group and a dehydrated silica that is surface treated with a MAO co-catalyst.

In contrast to the teachings of the cited references, the supported metallocene catalysts of the invention as presently claimed differ from the supported metallocene catalysts of the cited references in that they have different functional groups in the metallocene compound. Applicants' supported metallocene catalysts are formed by cleaving a C-O (carbon-oxygen) bond by a reacting a siloxane group (-Si-O-Si-) having high reactivity of the dehydroxylated silica support and an alkoxy group (A'-O-, wherein A' is methoxymethyl, t-butoxymethyl, tetrahydropyranyl, tetrahydrofuranyl, 1-ethoxyethyl, 1-methyl-1-methoxyethyl, and t-butyl) of the metallocene compound. The metallocene compounds of the invention as presently claimed are also different from those of the cited references. The metallocene compounds as presently claimed do not contain a "silicon functional group" as in Lee II, McNally, or Sancho Royo, and the metallocene compounds as presently claimed do not include an "alcohol functional group" as in Llinas et al. The A'-O- group (A' = methoxymethyl, t-butoxymethyl, tetrahydropyranyl, tetrahydrofuranyl, 1-ethoxyethyl, 1-methyl-1-methoxyethyl, and t-butyl) in the metallocene compounds as presently claimed is not suggested in the general formula or Examples of McNally. As discussed above, the process of preparing the catalyst of the present invention differs from that of the cited references. The cited references do not disclose or suggest a preparation method wherein the metallocene is supported on a dehydrated silica surface by cleaving the C-O bond of an "alkoxy group" of the metallocene compound, as does Applicants' method.

Moreover, Applicants have discovered that the metallocene catalysts recited in the claims exhibit unexpected and nonobvious superior performance compared to conventional metallocene

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catalysts. "A greater than expected result is an evidentiary factor pertinent to the legal conclusion of obviousness ... of the claims at issue." *In re Corkill*, 711 F.2d 1496, 226 USPQ 1005 (Fed. Cir. 1985). Applicants have discovered that supported catalysts derived from metallocenes containing such groups exhibit unexpectedly superior properties including reduced reactor fouling and better defined bulk density of polymer produced by the supported catalyst when compared to metallocenes containing other alkoxy groups, as discussed in the Examples of the present application. The attached Declaration of Bun Yeoul Lee includes experimental data demonstrating unexpectedly superior activity of the claimed catalysts. See, for example, the activity of the catalyst of Example 5 of the attached declaration (activity of 6.73 kg PE / mmol Zr hr) compared with the reported activity of the catalysts of the cited references when converted to the same unit of activity (Lee II : 1.51 kg PE / mmol Zr hr, McNally : 0.40 kg PE / mmol Zr hr, Sancho Royo 3.05 kg PE / mmol Zr hr, Llinas et al. : 3.24 kg PE / mmol Zr hr).

Accordingly, Applicants respectfully request that the rejection be withdrawn.

CONCLUSION

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is in condition for allowance. Should the Examiner have any remaining concerns that might prevent the prompt allowance of the application, the Examiner is respectfully invited to contact the undersigned at the telephone number below.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 2/15/05

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